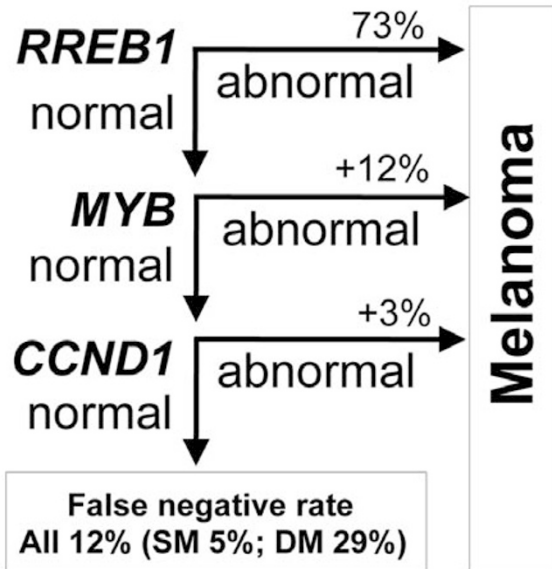


DM cases. Hybridizations were performed using commercially available *RREB1*/*MYB/CCND1* probes and established diagnostic cutoffs. For literature review of test performance in conventional melanoma we performed pubmed searches in combination with manual review of references and tabulated the number of abnormal vs. tested cases for each probe and overall sensitivity comparisons. Routine test performance measures were calculated and statistical significance was defined as $P < 0.05$.

Results: We performed a total of 123 hybridizations in 15 SM, 4 mixed and 14 DM cases. The assay was overall 88% sensitive ($n=29$ true positives). Although the sensitivity in DM was substantially lower ($10/14=71\%$ DM whereas $18/19=95\%$ SM or $304/360=84\%$ conventional melanoma), the differences did not reach statistical significance (P -range= $0.14-1.0$; Chi-square). Sensitivity by individual probesets was *RREB1* ($24/32=75\%$), *MYB* ($10/27=37\%$) and *CCND1* ($6/29=21\%$). Due to the relatively high sensitivity of *RREB1*, our results indicate that a consecutive FISH-testing algorithm (Figure 1) can drastically reduce the number of hybridizations (i.e., from $n=123$ to $n=57$). **Conclusions:** The triple FISH assay employing *RREB1*, *MYB* and *CCND1* probe sets is highly sensitive (88%) in SM/DM. We provide evidence for a practically efficient consecutive testing algorithm (Figure 1). Notably, the relatively high false negative rate in DM underscores the need for an additional reliable confirmatory melanoma assay and emphasizes the biological differences in this melanoma subtype.



583 HMG2 Is a Reliable Immunohistochemical Marker for Separating Melanoma from Nevi

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Background: Morphologically distinguishing malignant melanoma from nevi, benign or dysplastic can be a very challenging task. Current immunohistochemical (IHC) markers are not reliable for separating malignant melanoma from nevi based upon their cytoplasmic/nuclear staining patterns. High-mobility group AT-hook 2 (HMG2) is a non-histone nuclear binding protein and an oncofetal protein, which is overexpressed in embryonic tissue and many malignant neoplasms, including ovarian cancer, but rarely in normal tissue. A study of this IHC marker was conducted for the identification of melanoma and differentiation from nevi.

Design: Surgical specimens of 38 cases of nevi and 47 cases of malignant melanoma were included in the study. One whole-slide section from each case was stained with monoclonal anti-HMG2. Staining intensity was scored as 0 (negative), 1-2 (weak), 3 (moderate), 4 (strong); the labeling extent was tabulated as 0 (less than 5% positive cells), 1 (5-25% positive cells), 2 (26-75% positive cells), and 3 (greater than 75% positive cells).

Results: Of 47 cases of malignant melanoma, HMG2 was expressed in 30 cases (63.8%) with a nuclear staining pattern. Of the 30 positive cases, 8 presented strong staining and greater than 75% positive cells; 13 cases showed moderate staining and 26-75% positive cells; and 9 cases demonstrated weak staining and 5-25% positive cells. Of 38 cases of nevi, only 2 cases (5.2%) were positive with weak staining and less than 50% positive cells.

Conclusions: HMG2 is a useful marker for melanocytic lesions and can be used in differentiation of malignant melanoma from nevi.

584 The Photoprotective Effect of American Ginseng on Ultraviolet Radiation Exposed Skin

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Background: Solar damage of the skin is mainly due to the ultraviolet radiation (UVR) exposure. UVR plays important roles in both skin aging and skin carcinogenesis, which are mostly secondary to chronic UVR exposure. Depending on the wavelength, UVRs penetrate into human skin differently: UVA penetrates to the papillary dermis, while

the UVB reaches only the epidermis. The immediate effects of UV exposure include tanning, sunburn and porphyria cutanea tarda, which presents as blistering at sun-exposed skin, especially hands and face. In this study, we are exploring the protective effects of American Ginseng (*Panax quinquefolius*) extract on UVB induced skin damage in hairless mice.

Design: The acute UV-induced skin injury was examined in adult female hairless mice (SKH-1) 24 hr after UVB (300mJ/cm²) exposure. Ginseng extracts were topically applied on the backs of the mice. Mice were sacrificed 24 hours after UV exposure. Skin from the back and blood samples were collected. Histological analysis and cytokine quantification were performed from samples collected.

Results: UV exposure induced similar skin damage as seen in human skin, including epidermal vacuolar alteration, vesiculobullous changes at dermal-epidermal junction, disorganized stratum basale, and necrosis. Minimal acute inflammation was identified. Topical application of ginseng extract on the backs of the mice for three consecutive days prior to UV exposure provided significant protective effect with no or less severe vesiculobullous changes. Skin tissue cytokine analysis revealed that UV radiation resulted in an increase in TNF and IL-10, but not IL-1 β levels. Ginseng pretreatment reduced cytokine response to UV exposure.

Conclusions: Our data suggest that American Ginseng extract showed protective effects against UV induced acute skin damage. (Funding from Ontario Research Fund, Ministry of Research and Innovation).

Education

585 Editorial Board Membership of Pathology Journals: A Social Network Analysis

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Background: In the world of academic medicine where publication is an essential part of the job description, editorial board members of the journals—the gatekeepers of knowledge—carry a very important role. The selection process of these individuals is mostly not transparent. There may be overlap amongst the editorial boards, which may influence publication type, quality etc. The aim of this study is to identify the editorial board members of the most commonly read general (nonspecialty) pathology journals and assess the overlap among them.

Design: Top 40 Pathology journals with the highest impact factor in 2013 were identified. Journals that are mostly publishing basic science articles or specialized pathology (e.g. neuropathology, cytopathology etc.) were excluded from the study. The editorial board member lists of individual journals were identified from the journals' websites. Data collection and analysis were conducted in Excel, Netdraw and UCINET with two-mode affiliation data.

Results: The data set is composed of 13 journals (Table) and 1173 individuals who are editorial board members of these journals. 285 of 1173 (24.3%) individuals are editorial members in multiple journals (range: 2–8). Affiliation data were mapped in the Figure, where red dots depict the individuals with ≥ 3 editorial affiliations and blue dots depict sampled journals.

Pathology Journals and Impact Factors

No	Journal Name	Impact Factor
1	Journal of Pathology	7.585
2	Modern Pathology	5.253
3	American Journal of Surgical Pathology	4.868
4	American Journal of Pathology	4.522
5	Laboratory Investigation	3.961
6	Advances in Anatomic Pathology	3.412
7	American Journal of Clinical Pathology	2.881
8	Histopathology	2.857
9	Human Pathology	2.843
10	Archives of Pathology and Laboratory Medicine	2.781
11	Virchows Archive	2.676
12	Pathology	2.657
13	Journal of Clinical Pathology	2.435



Conclusions: Majority of the individuals (75.7%) hold a single editorship; however, a quarter of the individuals hold at least 2 editorships. There is a high interconnectedness among the journals. The overlap of the editorial boards is not associated with the impact factor; however, the journals which have more overlap are more commonly read among pathologists. There is more overlap among the journals that publish articles with similar content.

586 Development of 10-Minute Asynchronous Software Modules for Pathology Resident Workflow, Learning and Research Using Adobe Captivate 7.0

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Background: Despite technologic advances in the past decade, there is a dearth of focused video-based e-learning modules specifically targeted towards improving the daily workflow and education of housestaff (HS) in pathology. Specifically, over 90% of scope-based and static presentation modules in most places otherwise lack significant informatics infrastructural support for developing interactive e-modules. Furthermore, knowledge of a barrage of software suites has become imperative in the daily operations for HS at various PGY levels of training. More specifically, there is a critical need for development of focused, interactive e-learning tools for not only board review, but also other aspects of daily workflow, learning and research.

Design: A first step was identification of areas in HS daily workflow in any rotation where incorporation of such modules could be beneficial. These included logistic, learning and instructor-blinded self-assessment processes at the end of a rotation. Specifically, each e-learning video module was designed not to go over 10 minutes in order to provide focused non-time-intensive instruction based on a visual, auditory and kinesthetic (VAK) model. Additionally, 5 multiple choice questions are presented at the end of each module for the purpose of self-assessment, accompanied by explanations of all possible answers. Sessions were stored on intranet servers for in-hospital or at-home access. Adobe Captivate 7.0 was specifically used as the primary platform for module development owing to ease of use.

Results: The specific areas in need of such modules were: 1] daily workflow including Copath stain ordering and report formatting; 2] short lectures in hematopathology including asynchronous topics not covered in didactics on specific lymphoma entities, with relevant study questions; 3] research (Microsoft Excel data cleaning, basic biostatistics data analysis and graphing within STATA, image editing in Adobe Photoshop/Illustrator for publications). All were developed within Adobe Captivate 7 utilizing screen capture and narrative video tutorials, which were designed to be functionally cross compatible between PC and Mac platforms as well as mobile devices including Ipad.

Conclusions: Adobe Captivate offers an easy and coding-free means of developing e-learning modules specifically designed for pathology housestaff. Such 10-minute modules are an effective means of not only delivering interactive didactic content but also to complement and enhance efficiency in various aspects of daily workflow and academic development.

587 Trends in Surgical Pathology Training

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Background: For most residents training in anatomic pathology, a significant portion of residency is spent on surgical pathology (SP) rotations. However, information on the structure of SP rotations across programs is not widely available, and the efficacy of various training methods has not been well studied. Here, we assess current trends in SP training and evaluate factors associated with increased resident satisfaction and confidence.

Design: We created an online survey using Google Forms software. A link to the survey was e-mailed to all program directors, who were asked to forward the link to their residents. Participation was both voluntary and anonymous. Topics queried included: SP case load; number of pathologists' assistants; time spent performing gross and microscopic examination and signing out cases; availability of didactic sessions; and resident satisfaction and predicted confidence at completion of residency. Logistic regression analysis was used to assess factors associated with increased satisfaction and confidence.

Results: We received 159 responses (23.9% 1st year, 24.5% 2nd year, 20.1% 3rd year, and 31.4% 4th year). Very few residents (3.2%) have <10 months of required SP rotations during residency, while 39.5% have >15 months. Working over 80 hours/week is rare (2.5%). Most residents (80.5%) reported having partly or completely subspecialized sign out. Although almost all respondents (96.2%) reported that their program has at least 1 pathologists' assistant, 23.9% of residents said they regularly gross biopsies. Residents who regularly gross biopsies are significantly less satisfied with their training ($p=0.005$). A quarter of residents spend <10 hours/week previewing cases. Less previewing time is also significantly associated with decreased resident satisfaction ($p=0.006$). Few residents (3.9%) have <3 hours of didactic sessions per week, and most residents (82.1%) are able to attend over half of their lectures. Having more hours of lecture/week is significantly associated with greater satisfaction and confidence among residents ($p=0.017$ and $p<0.001$, respectively). While the majority of residents (74.5%) are very or mostly satisfied with their SP training, only 41.4% (and only 18% of 4th year residents) predict they will be very confident at independently diagnosing SP cases at the end of residency.

Conclusions: Resident rotations in SP vary greatly across institutions, though subspecialty sign out is now a part of most residents' training. This study suggests that decreasing biopsy grossing and increasing preview and lecture time may improve resident satisfaction and confidence.

588 Practice Gaps in Continuing Medical Education: Do Experts Really Know Best?

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Background: Continuing medical education (CME) is critical for medical professional development and required for maintenance of American Board of Pathology certification. CME content development is a continually evolving process that requires identification of learner educational needs and "practice gaps" between state-of-the-art knowledge

and routine implementation. Currently, it is not entirely clear how educators should best identify educational needs or practice gaps as they plan CME curricula. Traditionally, experts have identified these gaps based on their individual experiences; however, regulatory organizations often argue that identification of such needs by content experts is not sufficient. We hypothesize that practice gaps identified by experts mirrors those by identified by learner self-evaluation.

Design: A professionally-designed survey focused specifically on the issue of endometrial biopsies was generated and sent electronically to 2 groups: expert gynecologic pathologists and non-expert pathologists. Non-experts were queried on a Likert scale to determine how often they required assistance to make a histologic diagnosis in 21 categories of diagnostic challenges in endometrial biopsy pathology. Experts designated the frequency of perceived practice gaps for each of the same 21 categories on a similar Likert scale.

Results: The survey was completed by 1047 non-gynecologic pathologists and 9 expert gynecologic pathologists. A Spearman rank correlation test showed strong correlation between the need for assistance with diagnosis by members and the perceived practice gap from experts ($\rho=0.74$). Further analysis showed the upper half of practice gaps identified by experts overlapped with non-experts in 10 of 11 categories (91%). Conversely, the upper half of the educational needs identified by non-experts overlapped with experts in 9 of 11 categories (82%). Multiple logistic regression analysis was performed to determine the impact of practice setting (private vs. academic) and level of experience on identification of educational needs in the non-experts and no differences were detected.

Conclusions: Practice gaps appreciated by a small group of experts can successfully determine the same educational needs identified by a large population of general pathology practitioners. These findings suggest that when generating CME curricula, determination of educational needs by a group of content experts is equally valid as identifying the same needs through survey of a large population of general pathologists.

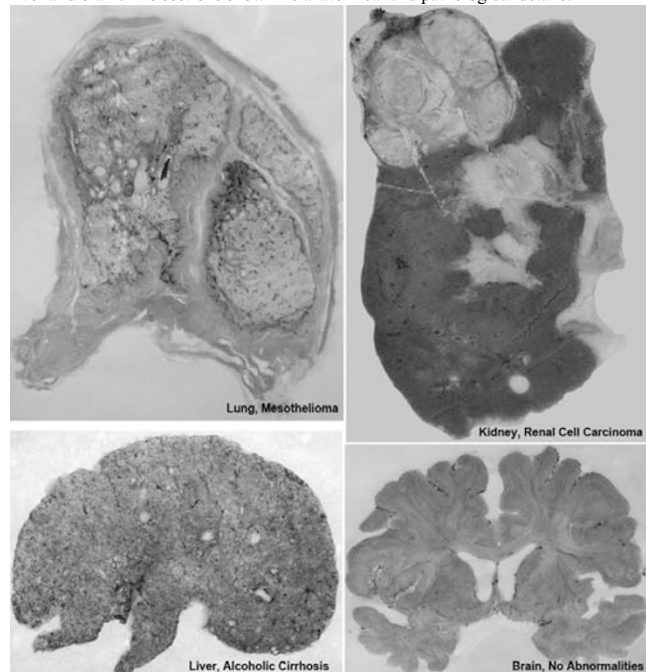
589 Less Toxic Method for Producing Giant Paper Organ Sections for Pathology and Anatomy Education

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Background: Medical school pathology educators have traditionally used formalin-fixed specimens to demonstrate the effects of diseases on target organs. However, these so-called "wet" tissues have some distinct disadvantages including the need for gloves, protective clothing and appropriate facilities to limit potential fixative moisture and fumes. The Gough-Wentworth technique for preparation of giant paper sections of lungs was originally designed to better observe and assess lung disease at the macroscopic level. It was subsequently modified to shorten preparation time and its use was also extended to other organs. Paper-mounted sections of solid organs have significant potential as an aid for teaching gross pathology. However, current techniques for preparing giant organ sections still include the use of the highly toxic ethylene glycol monoethyl ether (2-ethoxyethanol; EGEE). We investigated whether replacing EGEE with a less toxic dehydrating and clearing agent, Histo-Clear®, would allow production of high quality sections.

Design: Whimster's procedure for preparing rapid paper sections of lungs and other organs was modified to incorporate the xylene substitute, Histo-Clear®, in place of EGEE. A variety of specimens were obtained and used to prepare giant paper sections.

Results: Side-by-side comparisons of paper-mounted organ sections prepared using EGEE and Histo-Clear® were indistinguishable. In addition to lungs, excellent pathology teaching specimens were prepared from other solid organs including kidney, liver and brain. The sections show fine anatomical and pathological details.



Conclusions: The Gough-Wentworth technique of preparing rapid giant paper sections of organs was made less toxic without sacrificing quality by using Histo-Clear® as an alternative to EGEE. Paper-mounted sections offer a safe and portable way for studying macroscopic pathology and have great potential for use in the anatomy and pathology classroom as well as in the postgraduate pathology training.

590 Development of an Interactive Slide Study Set Utilizing Quick Response Codes and a Mobile Device

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Background: A quick response code (QR) is a two-dimensional bar code, also referred to as a matrix barcode, which can be linked to a website address with text information, videos, or pictures. These codes have become popular in the advertising industry because many applications are available that allow a mobile device with a camera (smartphone or tablet computer) to read QR codes. A variety of QR scanner applications are available for free from many App stores. Attaching QR codes to study set slides would make the residents' learning experience more interactive and enhance access to information suited for each individual's learning style.

Design: We generated one QR code for each study set slide from a free software available on the internet. The data recorded on the QR code consisted of various combinations of clinical history, gross pictures, highlights of the microscopic features demonstrated on the slide and a link to quiz questions pertaining to the related pathology. The QR codes were attached to the slides and residents with a mobile device capable of downloading a QR scanner application (most mobile devices with camera) were given the study set for review. Statistical data was collected for each resident when a quiz was completed.

Results: The addition of QR codes to a slide study set allows the reviewer to obtain rapid information without computer access, such as clinical history, text/audio-visual descriptions, and information pertaining to a pathologic process. The information collected from the web-based quizzes enables the reviewer to assess their knowledge on a topic and allows instructors to monitor individual resident progress.

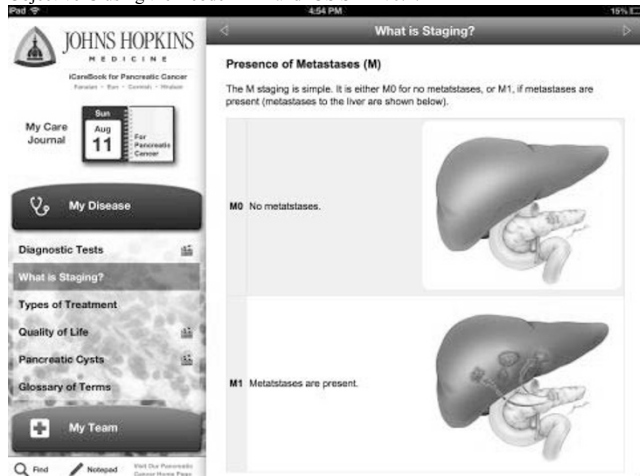
Conclusions: We describe a method to enhance a slide study set with the use of QR codes and a mobile device. This widely available technology can be used to provide rapid access to information without the use of a computer. The data recorded on the QR codes can easily be maintained to provide the most up-to-date information about any clinical entity. Furthermore, the web-based quizzes can provide residents with information on their areas of strength and weakness. With the advent of new ACGME program requirements, this method can potentially be expanded to track a resident's progress or to tailor lecture topics. We describe a few ways a QR code can be used in a pathology training program, but there are many potential educational applications.

591 The Johns Hopkins iCareBook for Pancreatic Cancer: A Model for Educational Patient-Centered Mobile Apps

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Background: This year 44,000 Americans will be diagnosed with pancreatic cancer and about 38,000 will die from it. When facing a diagnosis of pancreatic cancer, patients and their families commonly experience difficulties in understanding the disease and its treatments. We developed a novel teaching tool that takes advantage of the high-quality display and functionality of the Apple iPad, an ideal mobile platform for creating interactive applications (apps).

Design: The Johns Hopkins iCareBook for Pancreatic Cancer incorporates educational material and patient-centered personal tools. The app is divided into three sections. The "My Disease" section contains information about the pancreas and pancreatic cancer with emphasis on diagnosis and treatment. The content was created by leading experts in the field and includes text, illustrations, animations and videos. The "My Team" section describes the role of each specialty in a multidisciplinary care team and can be personalized with the names and pictures of the user's caregivers; it can even sync with iOS Contacts. Finally, the "My Care Journal" section has tools that help to navigate the health care system. It allows the user to track appointments, take notes, record symptoms (including pain), and document medications; it can sync with the iOS Calendar. The app has two modes: a personal mode that stores data, and a kiosk ("waiting room") mode that doesn't store personal data and is meant for shared iPads. The app was written in Objective-C using the Xcode4 IDE and iOS SDK v6.1.



Results: The app was released in the iTunes store on September 11, 2013. It can be downloaded at <https://itunes.apple.com/us/app/icarebook-hd/id697194060?mt=8> and is available at no cost. It is compatible with the iPad and requires iOS 6.1 or later.

Conclusions: We have successfully developed an app that educates patients, family members and friends, empowering them as they navigate the health care system with a diagnosis of pancreatic cancer. Novel educational apps such as this provide an ideal mechanism for pathologists to reach out to and interact with the general patient population.

592 The Effects of Clinical Data upon the Diagnostic Gaze Patterns of Pathologists and Trainees

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Background: Pathologists frequently utilize basic information provided by the clinician when rendering a diagnosis. While this information should generally not alter a clear microscopic diagnosis, no study has addressed the effect of this data upon pathologists' visual interpretation of the specimen. We present the first study of the pathologist's subconscious pattern of gaze when clinical information is matched, mismatched, or absent. We additionally examined these effects upon trainees, in order to evaluate the influence of clinical data over a range of expertise.

Design: Dermatopathologists and residents were asked to diagnose a series of 20 digital images of skin biopsy specimens with paired clinical information that was either matched, mismatched, or absent. The images were presented in a randomized order, on a Tobii T120 remote eye-tracker, which allowed for the recording of eye gaze patterns on a millisecond level. An ANOVA was employed to examine data for each diagnostic region (eg. - epidermis, junction, dermis), across the three categories of clinical information, and within expert and non-expert groups.

Results: Pathologists and trainees demonstrated similar relative distributions of fixations across diagnostic regions, however residents used a significantly greater number of fixations, regardless of the clinical data. Mismatched clinical information resulted in an increased number of fixations as compared to matched data, however this effect was greatest amongst trainees.

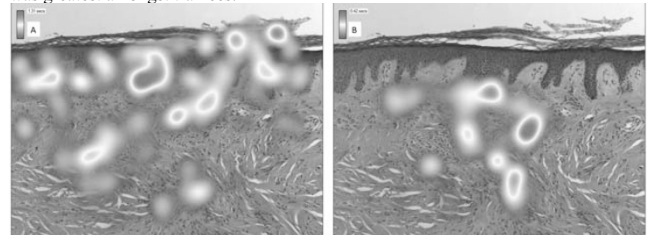


Figure 1: A) Heatmap of resident gaze patterns and B) Dermatopathologist gaze patterns over the same image with mismatched clinical data.

The time spent within the dermis before moving to other regions was greatest for dermatopathologists when information was mismatched, while this was not the case for trainees. An absence of information increased trainee fixations, though this effect was not significant for trained pathologists.

Conclusions: The pattern of fewer fixations utilized by dermatopathologists, while similar in relative distribution to trainees', is consistent with an acquired visual expertise. The addition of clinical data has the greatest effect upon trainees, however mismatched clinical data was also observed to cause a significant slowing of dermatopathologists' gaze. The effects of clinical data upon gaze prior to microscopic diagnosis are therefore relevant to both residents and practicing pathologists.

593 Impact of Subspecialization on Resident Workload Distribution of Breast and Gastrointestinal Surgical Specimens

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Background: As surgical pathology (SP) services shift to subspecialty sign-out, it has become challenging to ensure that residents receive balanced exposure to each subspecialty over the course of their training. This study serves to examine the impact of different models of subspecialty sign-out on the distribution of breast & GI specimens amongst SP residents.

Design: Using the Royal College of Pathologists 3rd ed. Guidelines on Staffing and Workload for Histopathology and Cytopathology Departments to calculate workload, the distribution of breast & gastrointestinal (GI) excision specimens was determined for 1 month (April 2013) using different models: 1) single subspecialty month; 2) weekly subspecialty; 3) 3-day gross/preview/sign-out cycle with breast and GI alternating (a) every other cycle or (b) every two cycles; 4) general non-subspecialized month (control). Workload distribution was quantified for each resident rotating on SP. Total sign-outs per year was based on the number of work days in 1 month for the subspecialized model and on 5 months of SP for the other models.

Results: Average (Avg) hours, standard deviation (SD) and variance (Var) were calculated for all models except the subspecialized monthly model (requires additional data).

Table 1. Workload Distribution

	Sign-outs / Year	BREAST		GI	
		Hours / Sign-out	Hours / Year	Hours / Sign-out	Hours / Year
1. Subspecialized Month	22	2.38	52.4	2.33	51.3
2. Weekly	20	1.52 to 3.22	30.3 to 64.3	1.38 to 3.05	27.7 to 61.0
		Avg 2.42	48.4	2.07	41.3
		SD 0.71		0.71	
		Var 0.51		0.50	
3a. Alternating #1	15 to 20	1.53 to 3.90	22.9 to 49.6	1.22 to 3.58	18.3 to 53.8
		Avg 2.38	37.4	2.30	36.7
		SD 0.53		0.92	
		Var 0.28		0.85	
3b. Alternating #2	10 to 20	1.19 to 3.10	12.9 to 62.1	1.17 to 4.58	18.3 to 68.8
		Avg 2.32	37.4	2.41	36.7
		SD 0.78		1.11	
		Var 0.61		1.22	
4. General Month	30 to 35	1.13 to 1.46	33.8 to 43.8	0.64 to 1.69	19.2 to 50.8
		Avg 1.22	37.4	1.19	36.7
		SD 0.12		0.35	
		Var 0.02		0.12	

Conclusions: Compared with general sign-out, subspecialty sign-out leads to a significant increase in variance of workload distribution (Table 1). Among the subspecialty models, alternating breast & GI every cycle results in less variance and offers consistent exposure over the course of 5 month-long SP rotations. While a dedicated subspecialty month provides the most hours per year, residents may have difficulty with knowledge retention unless safeguards are put in place to ensure ongoing exposure during the year. For programs contemplating a transition to subspecialty sign-out, this study highlights the importance of evaluating the impact of different models on resident workload distribution.

594 Interactive Case Vignette and Slide-Based Pathology Modules Improve Student Understanding of Disease Processes

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Background: Recent trends in medical education have emphasized incorporation of active learning strategies in preclinical training. During traditional lecture-based pathology education in the preclinical years, students have difficulty fully appreciating the clinical relevance of pathologic concepts. We tested an interactive pathology module using clinical vignettes and slides to determine whether it improves student understanding when used as an adjunct to traditional didactic methods.

Design: 11 microscopic slides of skin, bone, and soft tissue diseases were selected for inclusion in a voluntary pathology review module for second year medical students. Students were given 2 weeks to independently study clinical scenarios and questions related to pathophysiology, behavior, or management corresponding to each microscopic slide. During the review session, two pathologists facilitated groups of 2-3 medical students in describing histologic findings and reviewing important concepts for each case. To measure the effectiveness of this teaching methodology, final exam scores on questions requiring general pathology knowledge or interpretation of microscopic findings were statistically analyzed among students who attended the session (48/98) and those who did not (50/98). Students that participated in the review module also completed an anonymous survey following the final examination.

Results: The final exam consisted of 100 questions, of which 11 questions required interpretation of microscopic pathology, and 9 questions required knowledge of general pathologic concepts. There were a significantly greater number of correct answers on both sets of questions for students that participated in the review module compared to those who did not participate ($p < 0.05$). Those not attending the review module had a slightly higher overall mean exam score (83/100) compared to those attending the module (82.15/100); however, no significant difference existed between the groups on final exam performance. 45 of the 46 students who responded to the anonymous survey agreed or strongly agreed that this teaching methodology was an effective tool for learning pathology.

Conclusions: Overall, students attending the review module showed better exam performance not only on questions related to histology, but also on questions requiring general pathology knowledge. Results suggest that self-directed learning with case-based slides improves student understanding of disease and can be a useful tool for incorporating active learning in the preclinical pathology curriculum.

595 Modular Education System Improves Pathology Education in Renal and Genitourinary Systems

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Background: Medical students often have difficulty identifying important material while studying. This can lead to unfocused study, curricular dissatisfaction, and lack of critical knowledge for clinical practice. Modular education systems have been shown to address this by providing highly focused information. This pilot study evaluates a modular approach to genitourinary pathology education for 2nd year medical students.

Design: After IRB review, 422 2nd year medical students from the 2012 and 2013 classes at the University of Washington were enrolled. The control group consisted of 220 students in the 2012 2nd year class while the experimental group was 202 of the 2013 2nd year medical students. Controls were presented with standard lecture material after which they took a quiz on renal and genitourinary pathology. Experimental

subjects were presented with the same lecture material but were also granted access to web-based modules on the subjects. The modules focused on the clinical presentation, pathogenesis, molecular/genetic rearrangements, and differential diagnosis of renal and genitourinary topics with annotated gross and histologic photos. Both groups were then tested using identical secure standard USMLE Step-1 style questions and scores were compared to evaluate the effectiveness of the modules. The author of the modules did not have access to the test questions. Experimental subjects also completed a survey regarding the modules.

Results: The mean (SD) exam score for controls was 84.46 (6.26). Experimental subjects had a mean (SD) exam score of 88.45 (6.44), showing a statistically significant increase of 4 points ($p < 0.00001$). The Cohen's d for effect size was 0.63, showing that the modules had a medium to large effect on student performance according to Cohen's suggested guidelines. 97% of the experimental subjects expressed satisfaction with modules and 94% felt they would utilize additional modules if offered with the standard curriculum. 74% felt the modules were more effective than reading a textbook while 96% felt they were useful in addition to reading text. Moreover, 84% believed module review could replace a portion of lecture, leaving more class time for active learning.

Conclusions: This study suggests modular education significantly improves genitourinary pathology test scores. Students enjoyed the modules and many felt that they could replace a portion of lecture, leaving more opportunity for active learning (visual microscopy, cases, and gross labs). This pilot supports the development of additional modules and further research.

596 3D Printing of Anatomic Pathology Specimens

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Background: 3D imaging and printing technology has markedly advanced in the last two years. 3D imaging has been introduced to the medical field although still in its early phases of development and application. The aim is to explore the introduction of 3D printing into anatomic pathology. Specifically, the target is to create 3D models of human pathological specimens for educational purposes, and clinicopathological correlation at multidisciplinary team meetings.

Design: A 3D scanner was utilized to create 3D compatible printable modules in ".STL and .VRML formats". A Faro Edge ScanArm 3D scanner was employed (FARO, Lake Mary, USA); Faro Edge ScanArm emphasize an enhanced 3D scanning technology with an accuracy of $\pm 35\mu$ and a scanning rate of up to 45,120 points/sec. These features permit mapping every dimension of the specimen; in turn, providing a detailed printable 3D model of the object. Alternatively estimated 3D format file was created using high-resolution JPEG images. 3D printing was performed in multi-coloured utilizing a Zcorp 3D printing machine using an ABS plastic material (3D Creation LAB, Stoke on Trent, UK), and an Iris MCOR 3D printer using a FSC certified papers (Staples, Boston, USA).

Results: 3D printed models of anatomic pathology specimens including cancer resection specimens were created by both methods. 3D printed simulation of pathological specimens depicted the anatomical relationship of the targeted lesion and the adjacent normal tissues. The estimated 3D model utilizing a JPEG format as the base image was limited in its application, as it required significant interpretation of the image by the operator, "the 3D sculptor". Models generated by 3D scanning provide significantly greater detail and may prove more suitable for complex specimens.

Conclusions: 3D printing of anatomic pathology specimen is achievable. Although expensive, 3D printing is evolving and will render improved and affordable objects in the near future that can be mass produced and utilized for education and training purposes in academic and clinical settings.

597 Pathology Education in the Era of Virtual Microscopy

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Background: Histopathology has always played an integral role in medical school education. Correct identification of pathologic changes is an important feature of both medical school and USMLE examinations. Recently, modern techniques in imaging such as virtual microscopy have revolutionized our approach to pathologic diagnosis and medical education. At the medical school affiliated with our program, virtual microscopy currently plays a key role in the integrated medical curriculum taught to 2nd year medical students. Students have the option of clicking a link that directs them to a virtual slide. They are expected to scan the image and recognize key findings. To ensure that students have reviewed all key findings, still photographs with key annotated features are also presented to the students. In this study, we assessed whether moving from glass slides to virtual microscopy impacted medical student scores in written and practical clinical pathophysiology and therapeutics course.

Design: Medical student scores in the year preceding implementation and after implementation of virtual microscopy at our medical school were analyzed. The teaching faculty, duration of the course and structure of the didactic curriculum remained the same. Annotated still images used for glass slides were also used with virtual slides. The only change implemented was glass slides to virtual scanned slides.

Results: In the year preceding implementation of virtual microscopy the 2nd year medical school class comprised 103 students with a mean score of 76% (SD 6%), ranging from 88% to 58%. In the year following implementation of virtual microscopy, the class comprised 110 students who demonstrated a mean score of 83% (SD 6%), ranging from 95% to 64%.

Conclusions: This study retrospectively illustrates the positive effect of student acceptance of virtual microscopy, leading to more efficient learning as evidenced by an increase in mean exam scores (improved by greater than 1 standard deviation). This study does not take into account potential non-academic confounding factors such as changes in student selection criteria.

598 Web-Based Annotated Video Tutorials Incorporating Whole Slide Scans Are Effective Tools for Resident Training

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Background: At the scope training of residents is one of the best methods of teaching the finer points of microscopic pathology. However, this requires significant time commitment and the availability of microscopes large enough to accommodate all residents/fellows. We are not aware published studies that have assessed the utility of annotated videos combined with whole slide imaging (WSI) in resident training.

Design: Twelve different types of kidney tumors were selected. Whole slide scans (WSS) from one representative slide from each tumor were created using the 20x objective of the iScan Coreo Au (Ventana, Tucson, Arizona). A short annotated video tutorial using software from Camtasia Studio (V. 7.1.1, TechSmith Okemos, Michigan) detailing the diagnostic features of each renal tumor type was created and posted on a web page. Pathology residents (n=10) were given access to view the WSS and then asked to take a 13 question pre-test. They were then given access to view the educational video followed by a post-test. At this time they were asked to answer a short survey detailing their experience with this exercise.

Results: The participating residents were divided into two pools: junior residents (first and second year residents) and senior residents (third and fourth year residents). Junior residents scored an average of 31% on the pre-test and increased their scores significantly with an average of 79% on the post-test (p<0.017). Senior residents scored an average of 62% on the pre-test and also increased their scores significantly with an average of 85% on the post-test (p<0.0041). The resident responses to the survey were favorable, with most (75%) agreeing or strongly agreeing that the instructional video was helpful, introduced new information, and increased their diagnostic confidence.

Conclusions: Single topic web-based annotated videos combined with WSI are effective tools for resident education. Easy web-based access provides for greater flexibility for scheduling time for learning/training. The ability to rewind the video to better understand a finer point and store it indefinitely for future reference may well replace the traditional conference based approach to resident training.

599 Development and Implementation of a Milestones-Based Surgical Pathology Rotation Evaluation

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Background: In 2011, the Accreditation Council for Graduate Medical Education (ACGME) tasked each specialty with developing Milestones, intended to delineate skills and knowledge residents must acquire before graduation. Each Milestone consists of a progression through 5 levels for the skillset being evaluated. The Pathology Milestones Working Group developed 27 Milestones; each program director will be required to report results to the ACGME semi-annually beginning July 2014. As a single faculty member cannot observe each resident on every rotation sufficiently to assign a level, development of rotation-specific Milestones-based evaluations (MBE) which could then be aggregated for use by the Clinical Competency Committee (CCC), is desirable. As the most frequent rotation in our training program, surgical pathology was selected for initial rotation-specific evaluation development.

Design: Milestones pertinent to the rotation were extracted and wording was modified or multiple Milestones combined. One new Milestone was added regarding time management and each of the 6 competencies are included. Resident and faculty orientations were held to introduce the MBE, then 6 months before implementation, residents began filling out self-evaluations at the rotation's start. At the rotation midpoint, faculty discuss each resident's performance, and the rotation director meets with each resident. At the conclusion of the rotation, faculty achieve consensus to assign a level for each resident in each Milestone. The MBE is completed by the rotation director, with a narrative incorporating specific examples; this is reviewed by all faculty prior to submission.

Results: The surgical pathology MBE contains 13 Milestones and one "overall performance" item, which is not tied to levels, but has progressive descriptions of competence. Preliminary data collected over 9 months (15 self-evaluations including every PGY) show that residents subjectively progress as their PGY advances. Only one set of residents has received a final MBE thus far, however there was a near-global progression of at least 1/2 level during the rotation.

Conclusions: Adoption of MBE tailored to specific rotations has many benefits; it provides clear expectations to the residents, offers a more objective basis upon which faculty can judge their performance and aids the CCC in assigning levels on a semi-annual basis. Future areas of study will be to track resident progression as they advance in PGY level and to gather more data regarding concordance between resident self-assessment and faculty perception of their abilities.

600 Rare Tumor Registry in South France – SENOPATH Network and Webinars as a Tool for Diagnosis of Difficult Lesions of the Breast

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Background: In clinical practice, pathologists commonly face breast lesions that are difficult to diagnose. To reduce second opinion delay, erase geographical barrier and provide continuing education, we aimed to develop a pathologist regional network based on telepathology.

Design: With the support of ONCOMIP network (dedicated to oncology in the Midi-Pyrenees region), we invited pathologists experienced in breast pathology to join the SENOPATH group. Participating pathologists practise in private laboratories, university hospitals or comprehensive cancer center all over the region. Submitted cases are digitalized at the University Hospital, stored in a shared space with possible access via internet prior to the meeting. The group meets monthly, via a synchronized webinar and multithread microscope session. A consensual diagnosis and final pathology report is issued for each case, and sent to the referent clinician via the patient medical file securely hosted by ONCOMIP.

Results: From 2012 to 2013, 75 cases have been reviewed (18 meetings, average number of attending pathologists: 10). The number of cases reviewed increased from 2012 to 2013. Two main motives for review were identified: diagnostic routine difficulty (equivocal or discordant case, invasive/in situ, atypical/malignant lesion, immunohistochemistry pitfall) or rare tumor. The number of cases belonging to the former category was 41, while 34 belonged to the latter. Rare tumors included among others syringomatous tumor of the nipple, low-grade adenocarcinoma, myoepithelial, mucoepidermoid or secretory carcinomas, adenomyoepithelioma, atypical microglandular adenosis, sclerosing papillary hyperplasia without myoepithelium. Additional study was necessary and performed in 23% (IHC, FISH, CGH array).

Conclusions: The SENOPATH committee review for difficult or rare lesions of the breast has improved the pathologist network in South France. This group is regularly appealed by oncologists to solve difficult cases. Supported by the webinar tool, the educational impact is prominent, with a considerable progress in the region with regards to standardization of pathology processes, literature review and knowledge sharing.

601 Modular Education in Pathology: Improving Medical Student Knowledge Base and Increasing Opportunities for Active Learning

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Background: As pathology knowledge continues to expand, it is becoming increasingly difficult for medical students to identify important material while studying. This can lead to unfocused study, curricular dissatisfaction, and lack of knowledge essential for the national boards and clinical practice. Modular education systems have been shown to address this by providing highly focused information for study. At our institution, we are designing a comprehensive web-based pathology modular education system to provide a focused method for all medical students to learn pathology. These modules are designed for use on tablets and computers and focus on general pathologic principles and system based pathology. For each disease, the clinical presentation, pathogenesis, molecular data, and differential diagnosis is presented, along with clinico-pathologic cases, USMLE Step 1 board style questions, and references to seminal papers.

Design: After IRB review and informed consent, 40 2nd year medical students at the University of Washington received a pre-test on hematologic neoplasms, a subject that had previously been covered in lecture. Control subjects then reviewed lecture notes, recordings, and text over a 1 week period prior to taking a post-test. Experimental subjects were given the web-based module on the clinical presentation, pathogenesis, molecular/genetic rearrangements, and differential diagnosis with annotated gross and histologic photos. Experimental subjects completed the modules over a 1 week period without review of other resources prior to taking the post-test. Pre- and post-test scores were compared and student satisfaction was assessed.

Results: There was no statistical significance between groups on the pre-test (control: 76.1%, experimental: 76.9%). Experimental subjects scored significantly higher on the post-test than control subjects (control: 82.7%, experimental 87.4%) (p<0.007). 95% of the experimental subjects expressed satisfaction with modules and 73% felt the modules were more helpful than reading the text. 65% felt module review could replace a portion of lecture, leaving more class time for active learning.

Conclusions: This study suggests modular education may improve pathology learning and test scores. Students enjoyed the modules and a majority felt they would use this system in addition to standard curriculum. Many students felt review of the pathology modules could replace some lecture time, leaving more opportunity for active learning. This pilot supports the development of additional modules and further research.

602 An Application of Whole Slide Imaging towards Improving Trainee Interpretation of Frozen Sections

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Background: Interpretation of frozen section consultations is an important skill set for pathology trainees to develop. Residents and fellows may experience variable exposure to the types of challenges that face pathologists in this setting, based upon the cases they may be exposed to during their rotations. The aim of this study was to develop a teaching tool for increasing trainee exposure to challenging cases through a computer based approach, requiring the integration of clinical data, gross images and review of digitally scanned frozen section slides. This system provides immediate feedback to the trainees, and simultaneously identifies opportunities to improve deficiencies.

Design: All cases requiring intraoperative frozen section consultation between July 2012 and June 2013 were reviewed from the surgical files of a tertiary medical center. A total of 120 cases which were found to have specific teaching points were selected. Representative frozen section slides for each case were scanned using a whole slide imaging system. Selected information that would typically be available including patient presentation, radiology images and gross images were provided. Respondents submitted their interpretations for each case through an online form in a free text format after which they received immediate feedback including the interpretation rendered at the time of frozen section and the final diagnosis. Response concordance was categorized as 1) concordant, 2) discordant, same category (i.e. benign vs. malignant), 3) discordant, higher category or 4) discordant, lower category. Discordant responses were also categorized as to whether they would likely change intraoperative patient management.

Results: A total of 280 responses were submitted from trainees between PGY3 and PGY5. 78% of the responses were concordant with the attending pathologist diagnosis while 22% were discordant (16% same category, 4% higher category, 2% lower category). The interpretations were not likely to change patient management in 91% of the cases.

Conclusions: Our study demonstrates an application of whole slide imaging for improving trainee interpretation of frozen section consultations. Responses from residents and fellows correlated well with actual interpretations from attending pathologists. Based upon enthusiastic positive feedback from the respondents, ten cases per month will be added to the teaching set on a continuous basis, serving as a permanent database of challenging consultation cases for the training program and will continue to provide insight as to the types of cases trainees may struggle with.

603 The SCVP and AECVP Acute Cellular Rejection Tutorial: A Tool for Pathology Education and Providing Diagnostic Uniformity

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Background: Endomyocardial biopsy remains the standard by which cardiac rejection is determined in heart transplant recipients. A working formulation created by the International Society for Heart and Lung Transplantation (ISHLT) provides a standardized grading scale used by virtually all transplant centers. Although the ISHLT schema describes the histopathologic findings of rejection, it does not elaborate on the practical issues related to biopsy analysis, nor does it explain many of the pertinent non-rejection findings, including potential artifacts. Consequently, additional supplemental instruction is necessary to increase inter-institutional consistency.

Design: The SCVP and AECVP created a web tutorial (www.scvp.net/acr) covering all aspects of acute cellular rejection. The tutorial covers 7 different facets of interpreting the endomyocardial biopsy, containing over 90 images and a self-administered whole slide image quiz. Since its inception, over 1,200 independent visits have been recorded to the tutorial. A survey to evaluate the utility of the tutorial was added in September, 2013 and has elicited 11 responses to date.

Results: All survey takers were pathologists across a diverse range of expertise with transplant endomyocardial biopsies. Of these respondents, >80% read the entire tutorial and over 90% rated it very good or excellent. Seventy-two percent of respondents found the information very useful and 27% felt the tutorial corrected misconceptions regarding transplant endomyocardial biopsies. Over 90% of respondents would recommend the tutorial to a colleague, while less than 10% would recommend the tutorial to a patient.

Conclusions: The acute cellular rejection tutorial is a useful educational tool for pathologists with any level of expertise in reading endomyocardial biopsies. It should serve to improve cross-institution comparisons. A survey of users found the tutorial to be of great value and worthy of recommendation to colleagues.

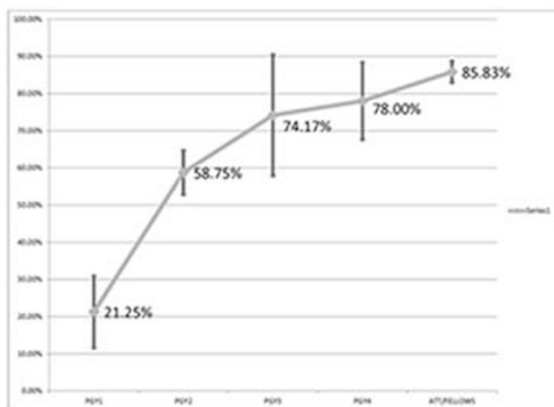
604 Resident Learning in Gastrointestinal Pathology: Opportunities for Teaching Improvement

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Background: Gastrointestinal (GI) pathology represents one of the largest portions of the diagnostic services provided by practicing pathologists. Therefore, committed teaching of pathology residents is extremely important. Few studies have been performed to assess the learning curve of residents in GI pathology. Our aim was to objectively evaluate the knowledge progression of a resident in GI pathology and identify key areas for improvement.

Design: Forty commonly encountered GI pathology entities were collected from daily pathology practice. They included 10 benign neoplastic conditions, 10 malignant neoplastic conditions, and 20 nonneoplastic conditions. A single representative H&E stained glass slide was chosen for each case. Pathologists at different training levels, including 5 at PGY 4, 3 at PGY 3, 4 at PGY 2, 4 at PGY 1, and 3 at fellow/attending level, participated together in a test examining 40 glass slides with one minute per case. The data was analyzed using the Microsoft Excel Statistics package.

Results: Statistical analysis of the data revealed the learning curve shown in Figure 1.



The steepest portion of the learning curve included the PGY 1 and PGY 2 trainees, indicating an accelerated acquisition of knowledge during this time period. The curve begins to plateau from the PGY 3 to fellow/attending levels. Interestingly, PGY 3 and PGY 4 exhibited the largest variation in scores, which we propose may be due to decisions on subspecialization and/or more intense learning in areas of interest for some individuals. Several cases showed overall poor performance (<50% correct) including ganglioneuroma, goblet cell carcinoma, esophageal intramucosal adenocarcinoma, celiac disease, gastric calcinosis, amyloidosis, cryptosporidiosis, and some benign polyps.

Conclusions: GI pathology is a high volume service and it is very important that pathology residents are adequately trained and confident in this subspecialty. Our study shows that we need to capitalize on the early receptive years of pathology resident training. In addition, we need to find ways to interest residents in their latter years in order to continue their growth in GI pathology. Finally, certain areas of poor performance were noted across all levels of training and should be addressed.

605 Curriculum Improvement and Milestone Competence Based on Kolb's Learning Theory

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Background: Traditional education of pathology residents uses an apprenticeship model with little awareness of student ability or learning styles. The traditional instructor-centric style may fail to engage all learners, possibly impairing their progression through the newly implemented ACGME milestones based competency assessments. This is particularly true in areas such as molecular pathology and informatics. Understanding how learners acquire, retain, and use information may be a key component of resident progression and faculty effectiveness. A well characterized instrument for understanding learning styles is the Kolb's learning style inventory (LSI). We undertook this study to examine if a redesigned genomic curriculum incorporating the core concept areas based on Kolb experiential learning theory and learning styles could be effective for residents and teachers in a pathology residency program.

Design: A total of 15 residents were followed over 18 months. The redesigned genomics curriculum was administered as a 12 hour didactic session (1 hr/week) in molecular pathology and cytogenetics under the direction of 4 faculty, including 2 doctoral level educators. With institutional IRB approval, the Kolb LSI online version was administered prior to the sessions. A pre and post course test, RISE scores, satisfaction surveys and post-course focus group session led by an unbiased third party were utilized to evaluate effectiveness of the course.

Results: The Kolb LSI identified a predominance of converging (n=7) and assimilating (n=6) styles in the residents. The faculty had diverging and converging styles. The residents' learning styles indicated that the educational activities best suited to them included teaching groups, observation, model making and questions. Relevant resources including articles, lectures, and web based material were made available ahead of the sessions. The sessions were conducted in a case based format accompanied by questions systematically addressing the subject matter with the course directors functioning as experts and coaches. The diverging residents were given a project to facilitate active experimentation. Both ACMGE satisfaction scores and RISE scores showed overall improvement with these methods.

Conclusions: Previous research suggests that learning styles can influence resident performance and progression in the residency program. Understanding and designing educational programs rooted in learning style theory can help the concept of milestone competence.

Endocrine Pathology

606 Two Main Subtypes of Aldosterone-Producing Adrenocortical Adenomas by Morphological and Expression Phenotype

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Background: Aldosteronism is still a considerable diagnostic challenge generally diagnosed in a 3-tiered system (initial screening, a confirmation of the diagnosis, and a determination of the specific subtype). Since the recognition that ¼ of cases are due to bilateral hyperplasia, the spectrum of adenomas needs further characterization to determine the origin of aldosterone secretion.

Design: We selected unilateral aldosterone-producing adrenocortical adenomas (AP-ACA, 33) responsible of primary aldosteronism defined by WHO criteria from a consecutive series of 98 ACA. We analyzed the histological features (growth pattern, nuclear characteristics, cytoplasmic staining qualities) of the tumor and the expression profile by quantitative RT-PCR of key molecular players of glomerulosa differentiation (SFRP2, β -catenin, AT1R, CYP21, CYP11B2, NURR1 and NUR77) in both the tumor and the surrounding parenchyma. RNA was extracted, cleaned from normal and neoplastic tissues (RNeasy columns), first-strand cDNA synthesized using T7-(dT24)-oligomer and used as template for cRNA synthesis. The peritumoral parenchyma was also evaluated for the cytohistological features of the glomerulosa and its extension into deep cortex/medulla and periadrenal soft tissues. Quantitative results were cross-validated (expression factor >2, significance <0.01). Variables were studied regarding morphological appearances of the tumor and the status of the peritumoral glomerulosa.

Results: Two main groups of AP-ACA were identified morphologically with a corresponding molecular profile. AP-ACA composed predominantly of clear foamy cells (10) that revealed minimal expression of AT1R, CYP21 and CYP11B2 and AP-ACA composed predominantly of eosinophilic cells (23) expressing significantly high AT1R, CYP21 and CYP11B2. The peritumoral parenchyma revealed functional